

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

A Method of Gripping Reinforcement Bars for Tensioning

- We, BETON- UND MONIERBAU AKTIEN-GESELLSCHAFT, of Goethestrasse 36a, Dusseldorf, German Federal Republic, a joint stock company organised under the laws of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 5 The invention relates to a method of gripping a reinforcement bar when tensioning it for use in reinforced concrete structures.
- 10 Methods are already known for tensioning round-section reinforcement bars. This may be done by means of threads formed on the bars after they have been cut to appropriate length and before they are cast in the concrete, the pre-tensioning system comprising tensioning couplings which are provided with cooperating internal threads. In other words, the procedure consists in rolling or cutting the threads into the bars independently of the subsequent tensioning process. It is also known to provide the ends of a reinforcement bar with formations produced by cold or hot upsetting or in some alternative way after the bars have been cut to length and before they are cast in. Correspondingly shaped parts are provided on the couplings of the tensioning system. Gripping jaws are also used for gripping the ends of the reinforcement bars protruding from the mould or from the hardened concrete of the precast part.
- 15 In various respects these known methods have certain drawbacks. Generally, it is inadvisable to shape the ends of the reinforcement bars prior to casting them into the concrete and after they have been cut to length, because any inaccuracy in length will cause trouble when attaching the tensioning means. Moreover, the shaping of the ends of reinforcement bars prior to use is also a disadvantage because the bars are
- usually cut longer than is required and it is then necessary later to cut off the excess, i.e. to sever the ends which protrude from the concrete. The wastage when using steel reinforcement bars in large quantities is a factor effecting the cost of a building, which increases the more steel is used per cubic yard of concrete. Clearly in large-scale or mass production of precast concrete parts of relatively short length, such as prestressed railway sleepers, the cost is considerably affected by the steel content factor. Furthermore the cost is often increased by the need for shaping the steel reinforcement bars during the actual production of the concrete part. There is thus an advantage in using reinforcement bars which do not call for the provision of a special gripping or anchoring means at their ends.
- 20 One object of the present invention is the elimination of the drawbacks involved in known and conventional methods and the provision of a method for the formation of a positive grip connection between the end of the reinforcement bar and a pretensioning coupling member.
- 25 According to the present invention a crest or projection on the non-circular cross-sectional profile of at least one end of a reinforcement bar is deformed by the internal threads of the tensioning socket coupling as the latter is screwed or twisted on to the end of the bar, after being first engaged axially over the end thereof for at least part of the final length of interengagement thereof sufficient to enable the tensioning load to be transmitted by the coupling to the bar.
- 30 The method proposed by the present invention has the advantage that special shaping of the end of the reinforcement bar on the site, for instance the cutting of threads prior to the application thereto of the coupling, is avoided. In the method according to the
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invention these two operations are combined in one.

In a preferred modification of the invention, at least one rib or like projection on the bar extending straight or helically along the length of the bar is deformed when the threaded socket of the coupling is twisted on to it. It will be readily understood that any interlocking deformation produced by twisting the coupling will create an intimate connection between the coupling and the end of the bar. Tests have confirmed that it is entirely sufficient for a projection on the cross-section of the bar to be gripped by the coupling, and that it is unnecessary for the entire cross-section to be involved in deformation.

In another modification of the method according to the present invention, transverse ribs extending at right angles or approximately at right angles to the longitudinal axis of the bar are likewise deformed by upsetting or cutting when the socket-shaped end of the coupling is twisted on to the end of the bar. As already mentioned, it is important, although not essential in the performance of the method according to the present invention, that the cross-section of the bar be provided with fairly continuous ribs. However, it should be noted that a bar with discontinuous projections on its cross-section might also be used, provided the projections were sufficiently close together to ensure that the transfer of tensile stress by the pretensioning system to the bar is not thereby impaired and the connection is sufficiently reliable.

Another modification of the method according to the invention consists in cutting or upsetting notches, grooves or the like into longitudinal ribs on the bar section by a short angular twist of the socket-shaped end of the coupling in a manner analogous to that of establishing a bayonet joint. The provision of a single longitudinal rib, even if helical, will not normally be enough for the reliable transmission of the required tensioning force from the tensioning device to the bar, unless the pitch of the helix is small.

Practical embodiments of the invention will now be described by way of example only, with reference to the accompanying drawings in which

Figures 1a and 1b show a first form of reinforcement bar prior to and after deformation, respectively;

Figures 2a and 2b show a second form of bar prior to and after deformation, respectively;

Figures 3a and 3b show a third form of reinforcement bar prior to and after deformation, respectively;

Figure 4 is a section through a socket tensioning coupling, taken on the line 4—4 of Figure 5;

Figure 5 is a section on the line 5—5 of Figure 4;

Figure 6 shows another form of socket tensioning coupling in section on the line 6—6 of Figure 7, and

Figure 7 is a section on the line 7—7 of Figure 6.

The several embodiments of reinforcement bar shown in Figs 1a, 2a and 3a are produced in conventional manner by hot or cold rolling. They are delivered to the site in the form seen in the drawing. The reinforcement bars are therefore originally undeformed.

The steel reinforcement bar illustrated in Figure 1a has one or two longitudinal ribs 1, the second rib (not shown) being diametrically opposite to the rib 1.

The two longitudinal ribs in the illustrated example are interconnected at equidistant intervals by staggered half-circumferential ribs 2, each of these latter ribs being less thick than the longitudinal ribs 1.

Figure 1b shows the same steel reinforcement bar after having been deformed in accordance with the invention. The ribs 1 and 2 have both been plastically deformed by the twisting on of the socket end of a coupling to be described below (Figs. 4—7). The grooves 3 thus formed or upset constitute a kind of thread so that, as will be described in greater detail, the tensioning coupling can be screwed on to the end of the bar. The deformations are confined to the ribs, the solid cross section of the steel reinforcement bar not being affected. In the course of extensive tests it was found that the resultant joint between the tensioning coupling and the ribs of the rolled steel section is sufficient for the transmission of the tensioning stress to the reinforcement bar without any risk.

Figure 2a shows the undeformed end of a so-called steel "Thor" section bar. It has two continuous longitudinal ribs 4 located at 180° which twist helically round the bar and intersects further intermediate helical ribs 5 pitched at an angle of 45° which are of lesser height than the main longitudinal rib 4.

When the tensioning coupling to be described below (Figs 4—7) has been screwed on to the end of the bar, grooves and notches 6 will also be cut or upset in the intermediate ribs 5 (Fig. 2b), the notches 6 in the longitudinal rib 4 being deeper than in the lower ribs 5.

In the form illustrated in Figs 3a and 3b the otherwise smooth surface of the reinforcement bar is broken by four straight longitudinal ribs 10 which are at 90°, and these, like the helical ribs 4 of Figs 2a and 2b, have notches upset in them by the action

of a coupling sleeve of the kind shown at 17 in Figure 4.

In Figure 4 the socket end of the coupling of a tensioning system is illustrated in longitudinal section. The tensioning rod 15 carries an external thread 16 for engagement of a sleeve or socket 17. In order to prevent the connection from working loose, a key 18 is provided and retained on the tensioning rod 15 by a ring 19.

The coupling sleeve or socket 17 has an internal thread 20 which is slightly coned or flared at its forward end. The cone or flare permits the coupling to be pushed axially over the end of a reinforcement bar. When the socket 17 has thus been applied to the end of the bar, the coupling is twisted on to the bar. As shown in Figs 1b and 2b, the ribs are deformed by an upsetting action and a reliable connection is formed between the coupling and the reinforcement bar. Pretensioning can then be applied immediately.

As soon as the pretensioning force is relieved the coupling can be disconnected from the tensioned bar by unscrewing it.

It has been found that one or two lengthwise ribs are not always sufficient for transmitting the tensioning stress from the coupling to the reinforcement bar. Several longitudinal ribs must thus be provided, unless the bar has further projections or crosswise rib sections.

In the embodiment shown in Figures 6 and 7 it is assumed that the reinforcement bar is longitudinally ribbed as shown in Figures 3a and 3b.

Whereas with the socket coupling 17 shown in Figures 4 and 5 the ribs or crests of the cross-sectional profile of the bar are plastically upset or deformed, it is also quite possible to form the positive grip formations on these ribs or crests by a cutting action, and whilst a bar as shown in Figures 3a and 3b can be notched by plastic deformation, this form of bar is also the easiest to subject to a cutting action. Thus, referring to Figures 6 and 7, a socket 21 which, as in the embodiment of Figure 4, is attached to a tensioning rod, is provided with four longitudinal internal flutes 23 (Figure 7) between wedge-section lands 25 in which are formed interrupted screw threads. These flutes register with the longitudinal ribs 10 in Figure 3a, and permit the socket 21 to be first pushed freely in the axial direction over the reinforcement bar. By then rotating the coupling socket 21 in the direction of the arrow 24 through an angle of less than 90°, the wedge-section lands 25 inside the bore 22 of the socket cut into the longitudinal ribs 10 (Figures 3a and 3b) and thus establish a positive grip connection between the socket 21 and the bar. This form of socket coupling will thus be seen to act in the manner of a conventional thread die.

Although in the foregoing description the non-circular cross-sectional profiles of the reinforcement bars are basically circular with definite ribs which constitute the crest or projections which are cut or upset by the internal threads on the socket coupling to form the positive grip connection, it is to be understood that other non-circular profiles can be used. For example, the crests or projections to be upset or cut may be constituted by the corners of a polygonal profile, or the profile may exhibit cusps which, if they are out-turned form the crests. If the cusps are in-turned, the backs or humps of the intervening curves form the crests or projections of the profile.

WHAT WE CLAIM IS:—

1. The method of gripping concrete reinforcement and like bars having ends of non-circular section which comprises twisting on the bar a tensioning socket coupling which is internally threaded so as to be axially engageable over one end of the bar for at least part of the depth of the socket so as to cut or upset complementary thread grooves in each crest or projection of the cross-sectional profile of the bar end for a sufficient distance lengthwise of the bar to transmit a required tensioning load.

2. The method according to claim 1 wherein the bar is formed, over at least its end portion which is to be gripped by the socket coupling, with at least one rib extending in a generally longitudinal direction.

3. The method according to claim 1 or 2 wherein at least the end portion of the bar has projections extending peripherally or at a large angle to the axis of the bar and adapted to be cut or upset by the internal thread on the socket.

4. The method according to claim 1, 2 or 3 wherein the socket has a continuous internal screw thread and its mouth is flared to constitute a lead for preliminary axial engagement over the end of the bar.

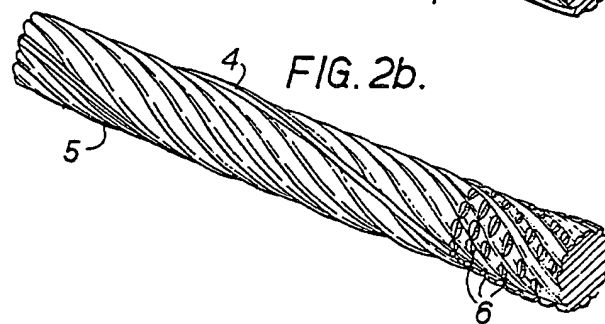
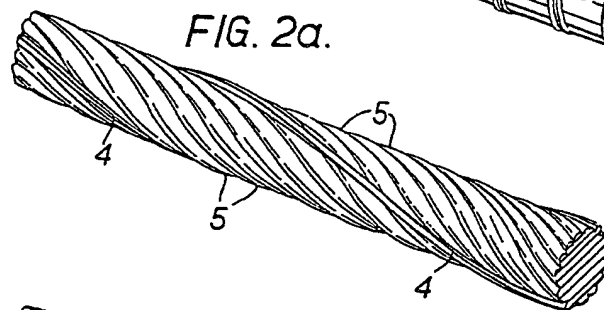
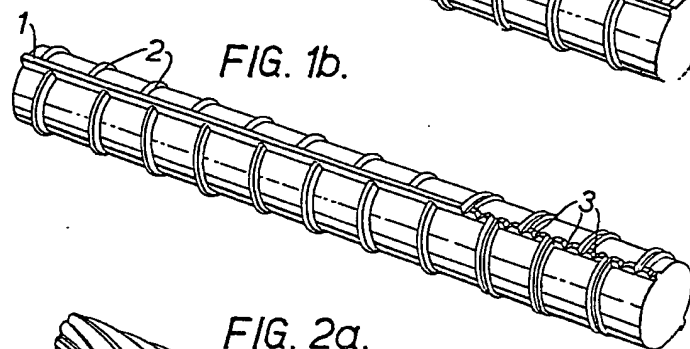
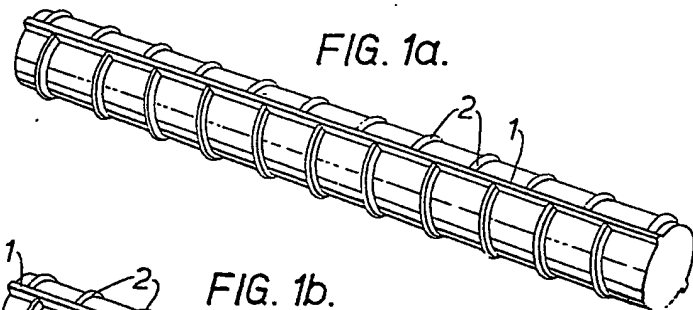
5. The method according to claim 4 wherein, after the preliminary axial engagement, the socket coupling is screwed onto the bar for a sufficient distance to ensure transmission of the tension load from the coupling to the bar.

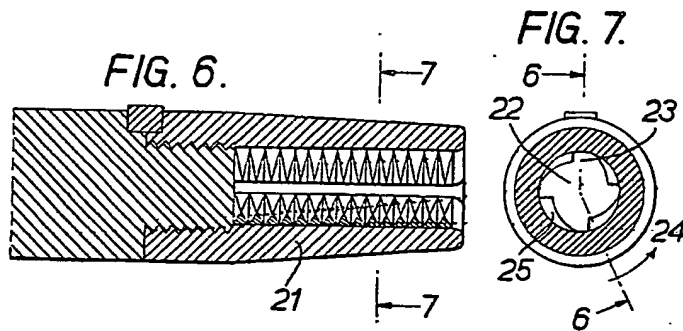
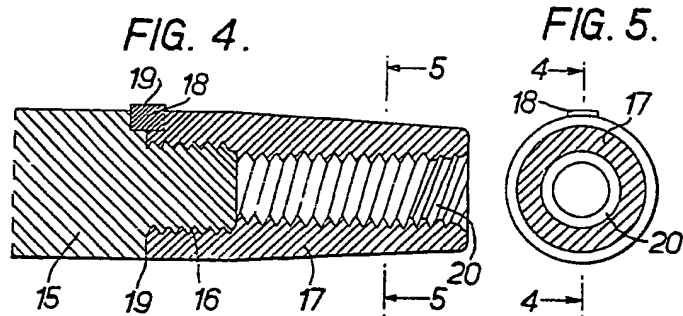
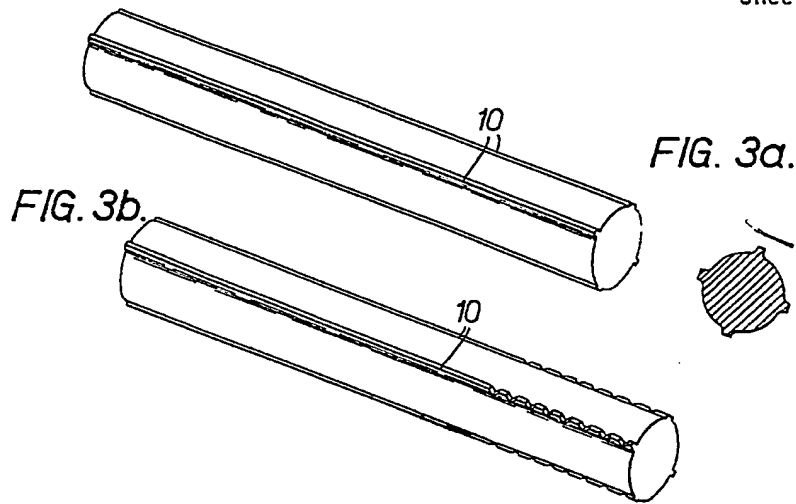
6. The method according to claim 1, 2 or 3 wherein the socket is formed with a screw thread which is interrupted by one or more longitudinal gaps or flutes each of which registers with a respective longitudinal projection on the cross-section of the bar, whereby the socket can be fully axially engaged with the bar and then twisted to cut or upset complementary thread grooves in each longitudinal projection.

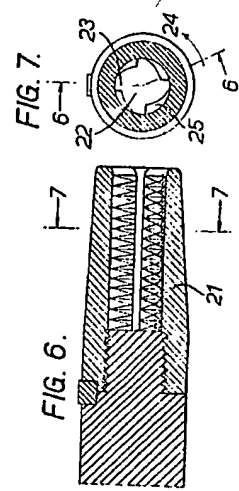
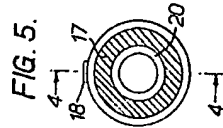
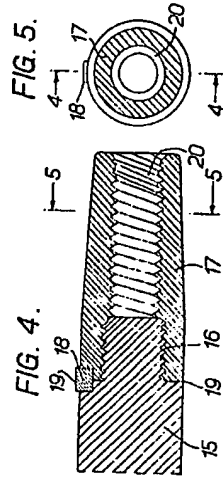
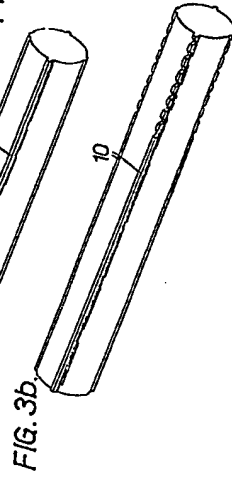
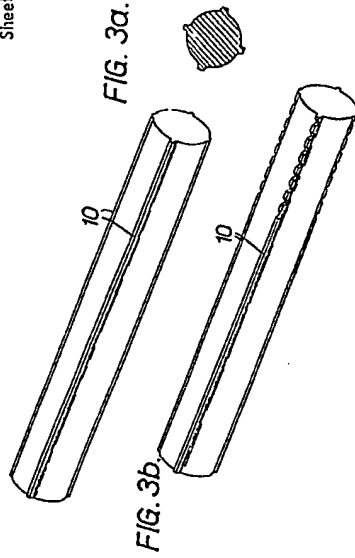
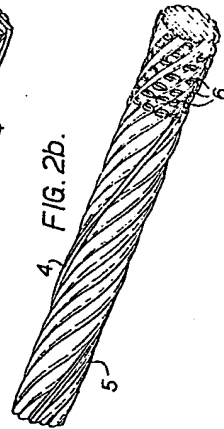
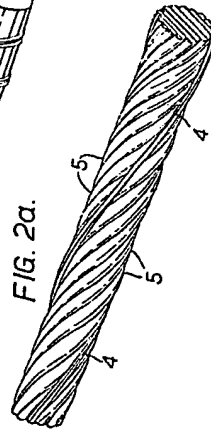
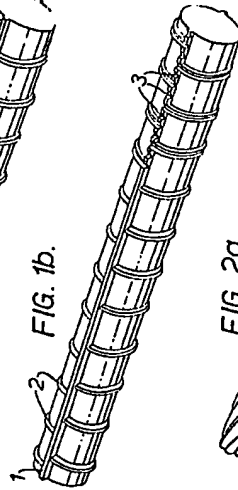
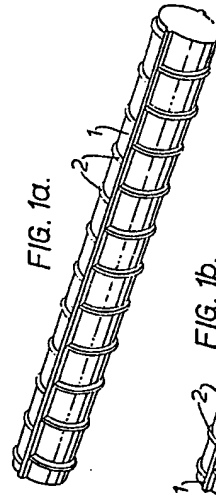
7. A bar tensioning socket for use in the method claimed in any one of claims 1—6 having an internal screw thread adapted to

- be at least partially engaged axially over a non-circular section end of a bar, such as a concrete reinforcement bar, and then to be twisted on the bar so as to cut or upset complementary screw thread grooves in each crest or projection of the cross-section of the bar.
- 5 8. The method according to any of claim 1—7 in combination with the step of applying the required tension to the bar through the socket coupling and maintaining the said tension for the necessary period.
- 10 9. A socket according to claim 8 wherein the mouth of the socket is flared for initial axial engagement over the bar end, and the screw thread is continuous for its operative length.
- 15 10. A socket according to claim 9 wherein the screw thread is interrupted by one or more longitudinal gaps or flutes each adapted to register with a respective crest or projection on the cross-sectional profile of the bar end.
- 20 11. The method of gripping concrete reinforcement and like bars substantially as hereinbefore described.
- 25 12. A socket coupling for gripping the end of a bar of non-circular cross-sectional profile substantially as hereinbefore described with reference to Figures 4—7 of the accompanying drawings.
- 30

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